PB-217 389

RADIUM SAFETY, SAFETY STORAGE RESEARCH AT THE SOUTHEASTERN RADIOLOGICAL HEALTH LABORATORY

Southeastern Radiological Health Laboratory
Montgomery, Alabama

1973

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 217 389

RADIUM

SAFETY SAFETY SAFETY

STORAGE STORAGE STORAGE

RESEARCH RESEARCH RESEARCH

AT THE SOUTHEASTERN RADIOLOGICAL HEALTH LABORATORY

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE • PUBLIC HEALTH SERVICE • ENVIRONMENTAL HEALTH SERVICE • BUREAU OF RADIOLOGICAL HEALTH

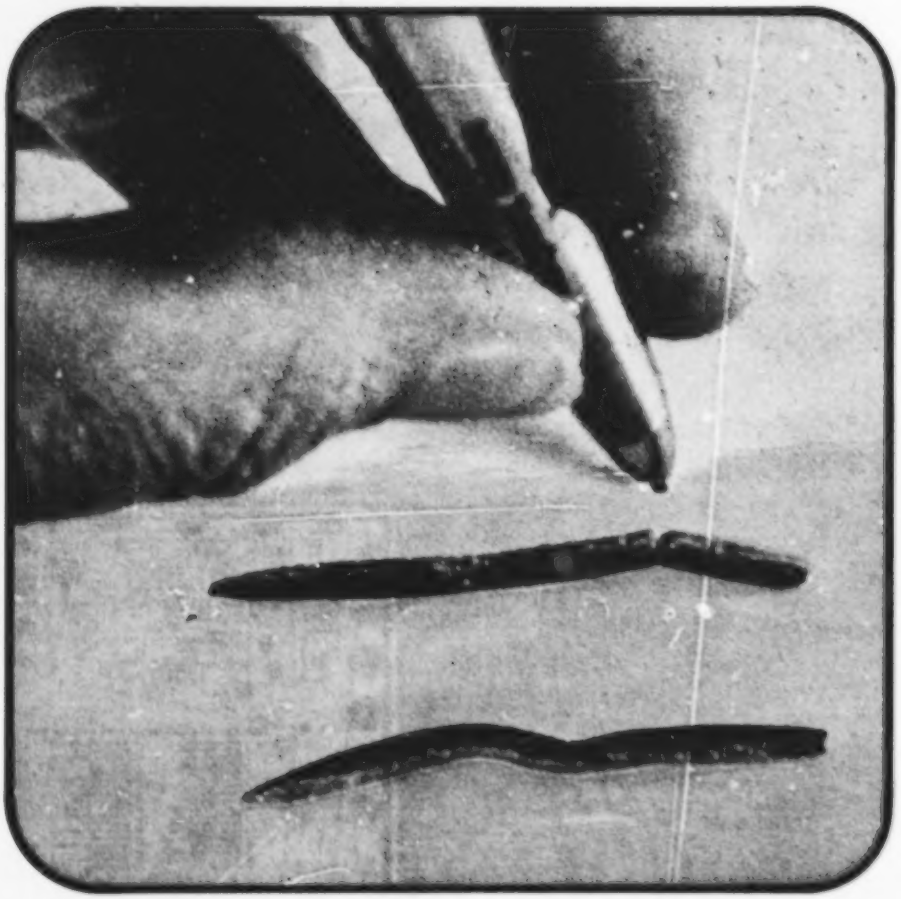
Details of illustrations in this document may be better studied on microfiche.

RADIUM RADIUM RADIUM
SERHL SERHL SERHL SERHL

The Southeastern Radiological Health Laboratory (SERHL), a regional laboratory of the Bureau of Radiological Health, conducts studies to expand and advance present knowledge and methodologies in the field of radiological health. The Laboratory, located on an eleven-acre site in Montgomery, Alabama, is active in environmental surveillance, monitoring programs, and research. Activities of the Laboratory are carried on in thirty buildings, as indicated in the ground plan, and involve the following laboratory branches:

- ELECTRONIC PRODUCTS BRANCH
- RADIATION BIOEFFECTS BRANCH
- TRAINING BRANCH
- ENVIRONMENTAL RESEARCH AND SERVICES BRANCH
- APPLIED RADIATION TECHNOLOGY BRANCH
- NUCLEAR FACILITIES BRANCH

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
PUBLIC HEALTH SERVICE, ECA, BRH
SOUTHEASTERN RADIOLOGICAL HEALTH LABORATORY

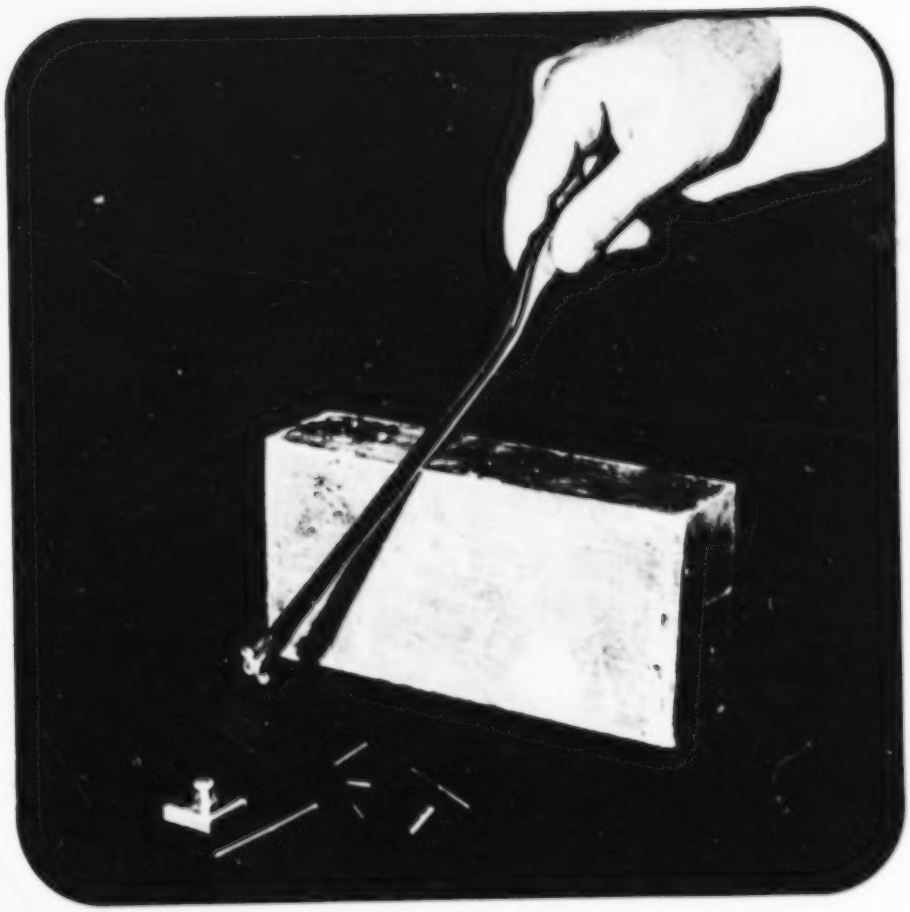


This booklet is designed to acquaint the public community and others interested in radium-226 with the capabilities and research programs being conducted at the Southeastern Radiological Health Laboratory to minimize radiation dangers of radium. Radium-226 is a radioactive element which has application in industry and particularly in medicine. Its use requires caution, inasmuch as when present in sufficient quantities the combined radiations of radium and its daughter products, beginning with gaseous radon, are hazardous to humans. Since its discovery about 70 years ago, about 1,300 grams of this nuclide are unaccounted for in the United States. Improper use of radium-loaded devices, sources, and damaged sources, such as these shown at the left, represents a radiation danger to health. Elimination or reduction of this health problem can be accomplished through application of proper handling, testing and management techniques in the use of radium. To this end, improvements in transportation, leak testing, and in assessment of radium and its radiation dose to humans are being studied. Several aspects of research activities are discussed, including safe storage of unwanted radium, development of effective leak-test methods, and handling equipment. Many of the techniques and devices described have proved useful to personnel working in this program and are presented for the benefit of others engaged in the study and use of radium.

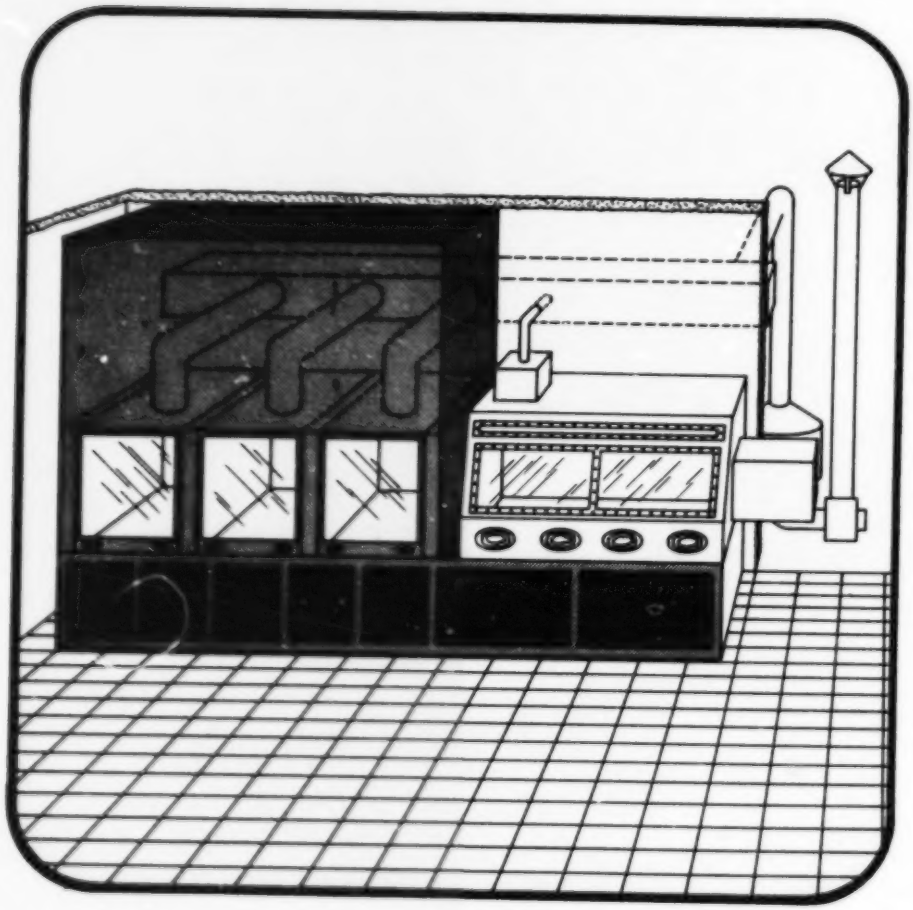
RADIUM RADIUM RADIUM
SAFETY SAFETY SAFETY

Since its discovery in 1898, about 200 grams of radium-226 were processed in the United States and nearly 1800 grams were imported. Of this total amount, approximately 700 grams have been accounted for and of this, 500 grams have been identified in sources licensed or registered for use in medical and non-medical facilities. The unaccountable radium can only be assumed as being lost, stolen, stored in dwellings or safe deposit boxes, disposed of as radioactive waste, involved in luminous compounds, exported or used in a multitude of unaccountable items such as electron tubes, static eliminators and other devices.

The Radioactive Materials Investigation Section at the Southeastern Radiological Health Laboratory functions to establish safety guidelines, techniques, and procedures for safe handling, use, transportation, and control of radium-226, a naturally occurring radionuclide, and to provide a means of disposal or long-term storage of hazardous and unwanted radium sources. Some of the various radium sources used in medical treatment are shown at the right. (Radium should not be confused with reactor-produced radioactive materials, and those naturally occurring radionuclides which are under the control of the Atomic Energy Commission.)



6

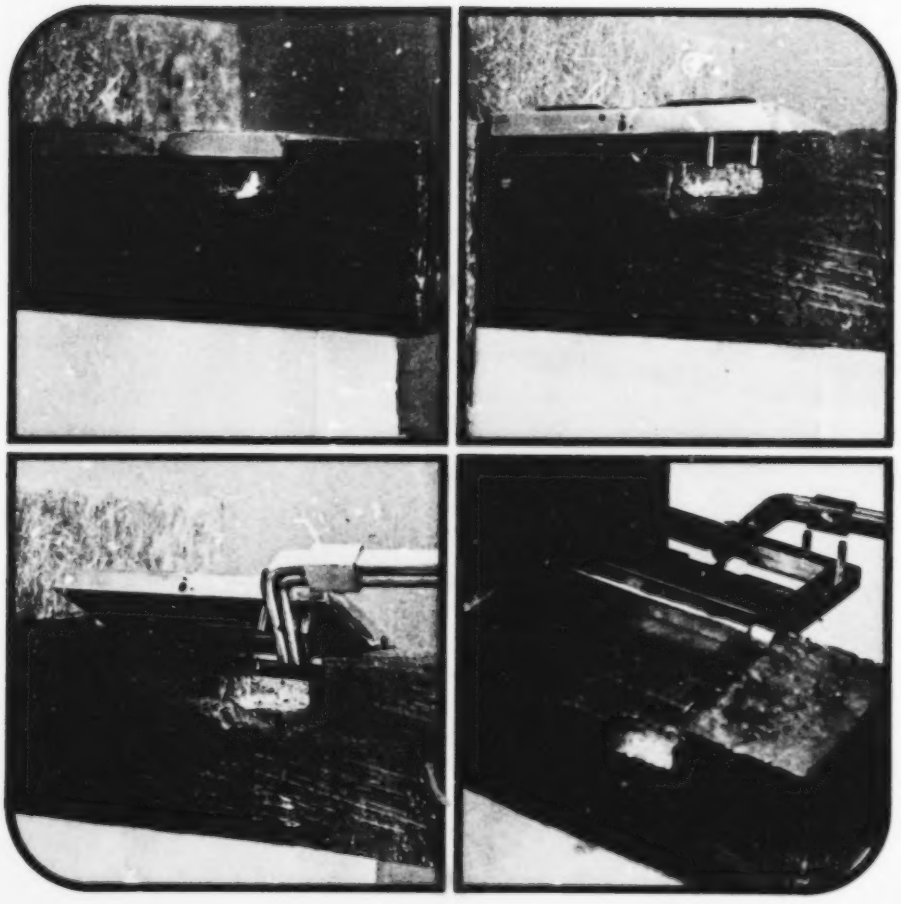


Unlike most radionuclides, radium is not consistently controlled, and there are no uniform standards for its safe handling and storage. Because of its radiations and physical and chemical properties, radium becomes a hazard to man when not properly used. Through the radium storage program, sources in varied physical conditions have been acquired from physicians, hospitals, industries, universities, and other institutions throughout the country. These sources provide the Section with opportunities to perform research in the control of external radiation exposure and environmental contamination. Storage and handling techniques, procedures to test radium-containing devices for leaking radon, environmental contamination criteria, efficient decontamination methods and physical aspects of sealed sources are investigated.

Because of biological hazards associated with radium, all radiation studies are conducted in ventilated laboratories with shielded chambers for radioisotope storage and hooded work areas, such as the one depicted at the left. Exhaust hoods used in research projects have specially designed air circulation systems involving absolute and charcoal filtration of air before it is discharged to the atmosphere.

Dissipation of radon is also controlled by radioisotope glove boxes, indispensable items of equipment in handling many radon experiments. These boxes serve as viewing chambers through which sources leaking radon may be safely inspected with a microscope or otherwise examined.

To minimize radiation exposure to personnel, special tools are required for opening various source containers. Several handling tools have been designed, built, and modified by the SERHL for use in removing and placing radium in storage. These include magnetic retrieving devices, long-handled wrenches, specially designed slotted wrenches and short- and long-handled tongs.

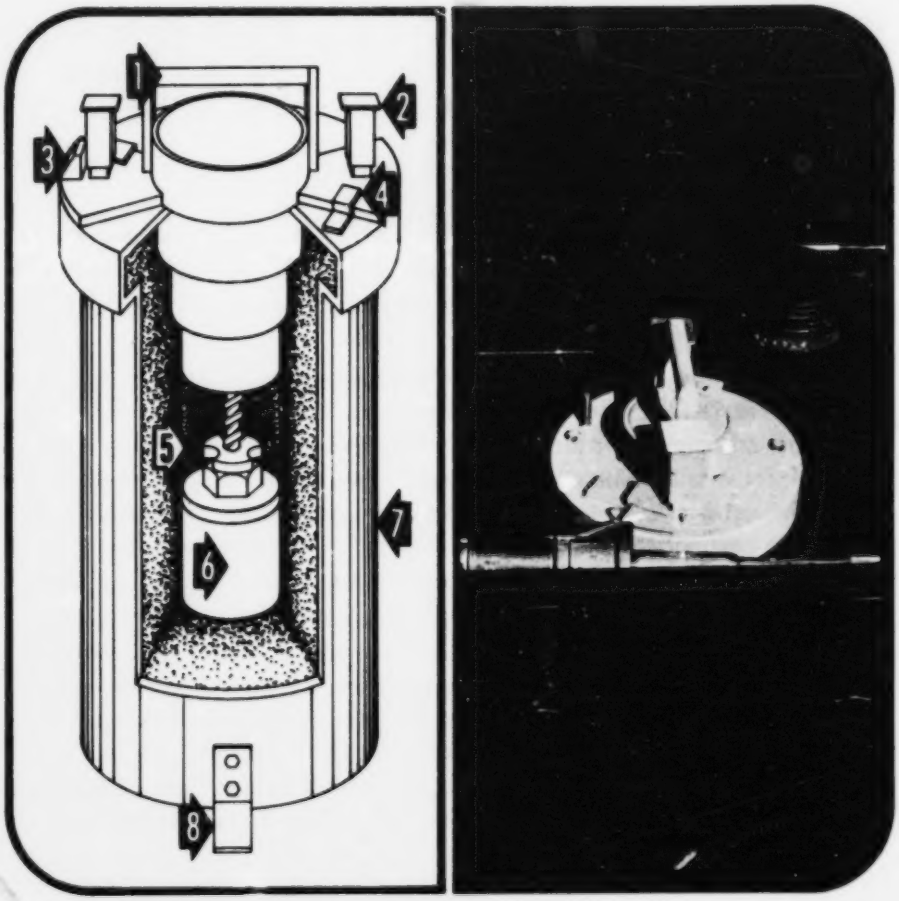


Specific protective hardware items for use by radium handlers have also been designed and tested. Among these is a protective device which may be attached to radium storage drawers to prevent accidental shearing of the protruding sources when the drawer is closed. The device was designed so that the drawer cannot be closed unless all sources are properly seated.

- UPPER LEFT: Normal position. All sources are correctly placed.
- UPPER RIGHT: Sources incorrectly placed – lid will not shut properly because lid is fixed in raised position by trigger cam and drawer cannot be closed.
- LOWER LEFT: Lift lid to open device and permit reseating of sources.
- LOWER RIGHT: Recock trigger mechanism.

Another protective device is a radium shipping container which contains a self-locking inner shield designed for radioactive sources and particularly radium. The lid of the shipping box cannot be closed unless the deflection plate is in proper alignment, and a trigger mechanism permits the closure assembly to lock properly only when a sealed cannister is in the shield. Within this shipping container, the screw-top cannister may be opened or sealed while in the shield. The shipping container has a self-locking latch, and a "Z" bar to hold the closure assembly to the shield. A bracket anchors the shield to the shipping box.

1. HANDLE
2. SELF-LOCKING LATCH
3. DEFLECTION PLATE
4. "Z" BAR
5. TRIGGER MECHANISM
6. SCREW-TOP CANNISTER
7. SHIELD
8. BRACKET


1
2
3
4
5
6
7
8

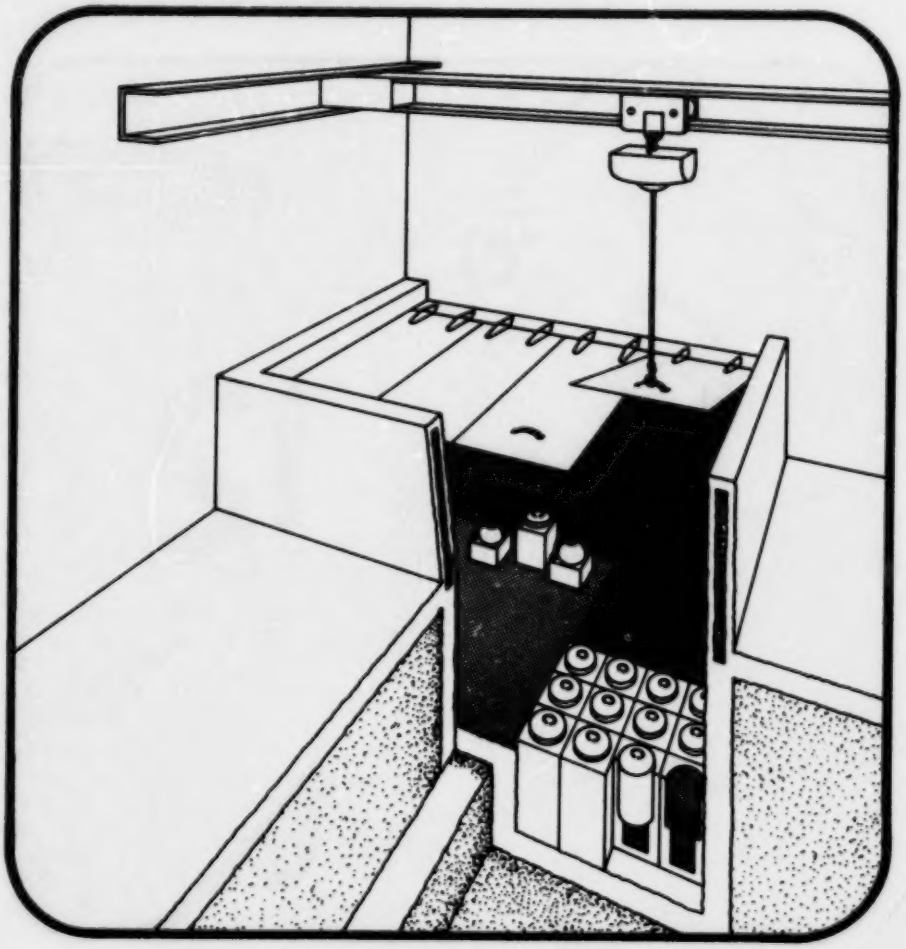
RADIUM RADIUM RADIUM
STORAGE STORAGE STORAGE

The SERHL facilities provide safe storage, burial, or disposal of unwanted or damaged radium sources which cannot be discarded as ordinary waste material due to the radioactive characteristics of radium.

A variety of sources, many of which are damaged and leaking radon, have been shipped to the SERHL for storage by physicians, hospitals, industries, universities, and other institutions. Leakage of the sources, or containers, is one of the major problems associated with the use of radium. Damaged or faulty sources emit radon, an odorless, invisible, radioactive gas, which can spread rapidly through the environment and constitute a radiation hazard to humans.

The procedure for submitting sources to the Laboratory for storage begins with a written application by the source owner requesting a transfer. This application is processed by the PHS Regional Representative through the State Health Department prior to its receipt at the Laboratory. Sources which are accepted for storage and which are not owned by the Federal Government are purchased from the owner for $1.00 per entire shipment. Arrangements for transfer and payment of transportation fees are made by the Laboratory. Some portable lead shields used for radium storage at the SERHL are shown to the right.

6
12

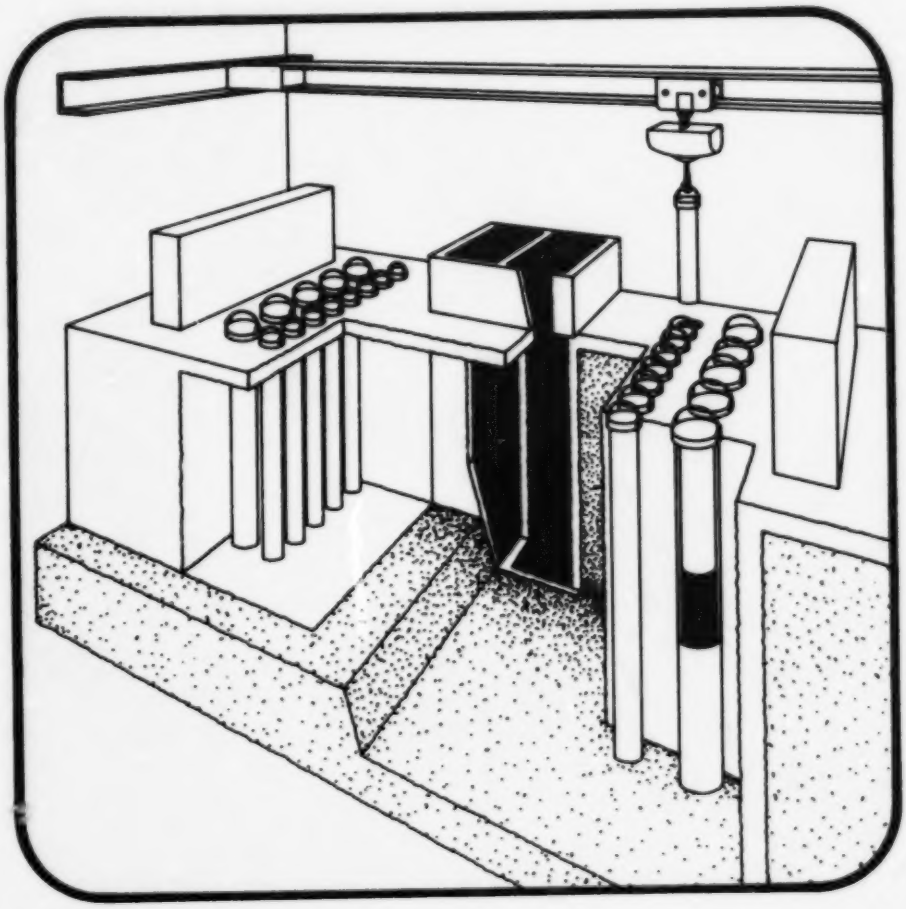


The radioisotopes storage facility is composed of three major units including a shielded bunker in the radium laboratory, subsurface chambers adjoining the radium laboratory, and a specially designed storage building separately situated from the laboratory.

The bunker storage system consists of five lead containers set in a steel lined concrete pedestal and is capable of safely holding about 200 mg ($\simeq$ 0.2 curie) of radium in each container.

Over 200 curies of radium can be handled in the subsurface storage pit shown at left. Sources containing more than 200 mg of radium are stored in heavily shielded containers. Many sealed radium sources stored in this unit are used for experimental studies. So that such sources may be removed and replaced readily, they are kept in portable lead shields (page 17) which may be removed by an overhead electric chain hoist.

For many of the shields, radium sources are placed in quick-open and quick-close containers (right). These containers are used only for storage and are effective in preventing escape of radon from leaking sources. Badly ruptured sources, or those substantially leaking radon, are covered by a special gelatin mixture which serves as an effective radon seal.

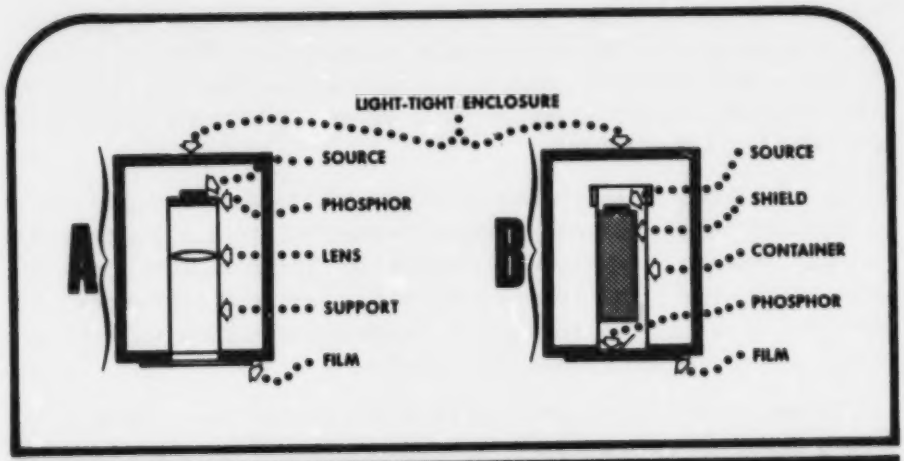


The largest storage area with an estimated potential capacity of over 1,000 curies is separate from the main laboratory and was designed for long-term storage of neutron sources consisting primarily of radium-berryllium mixtures. Twenty-six, 10-foot-long steel caissons buried in concrete with surface openings capped by 3-foot-thick concrete covers are used for permanent storage of sources which have very little application for radium research.

RADIUM RADIUM RADIUM RESEARCH RESEARCH RESEARCH

Radium has numerous useful industrial applications such as in painting of watch and instrument dials, and is used in medicine for treatment of cancer and particularly gynecological malignancies. For medical treatment, finely powdered radium salts are sealed in cells, needles, tubes, and plaques (see page 5) to allow only beneficial radiations to penetrate the tissues and to prevent harmful radioactive products from being discharged into the environment.

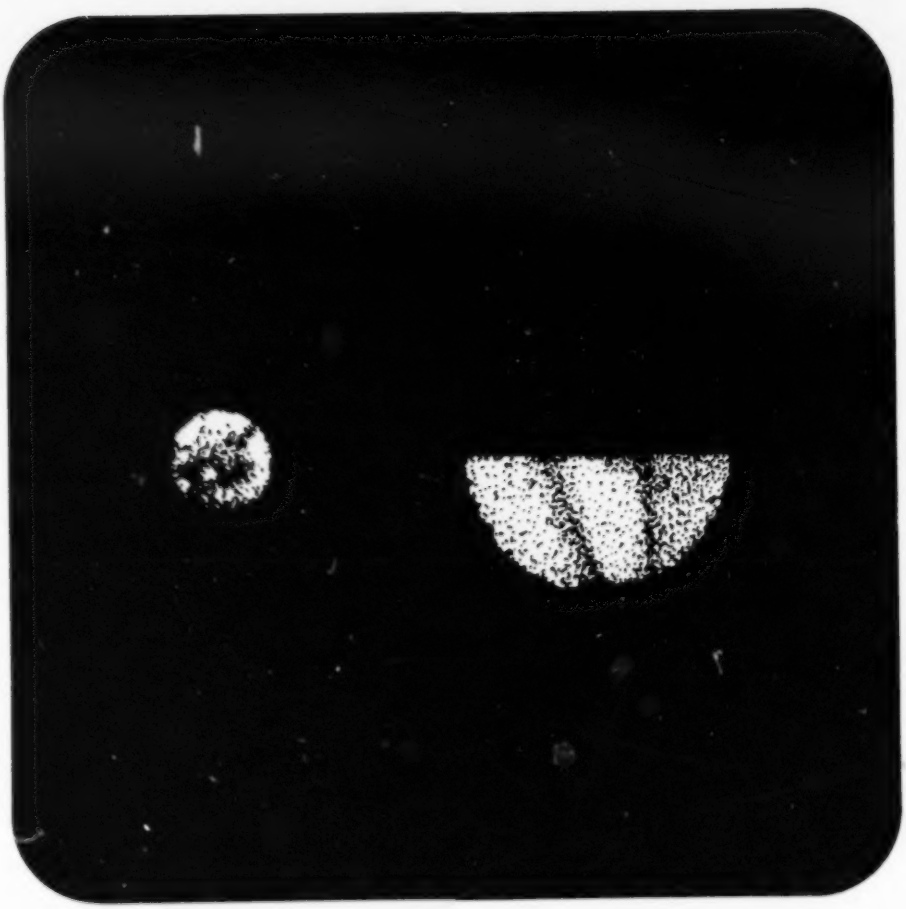
Although radon is not apparent to the naked eye, interaction of its radioactive rays on a phosphorescent substance emits light which can be seen in a photograph. Through research, the Radioactive Materials Investigation Section has developed two methods based on a rapid photographic technique in which pictures reveal the leaking or contaminated nature of a source. In one method (a) radiation effects of leakage and contamination are detected in a few minutes. The other technique (b) is more sensitive, but requires longer exposure time to produce a picture related to radon and products of radioactive decay arising from the radium source. Both of these methods are sensitive, economical, quick and require no electronic instrumentation for leak detection.

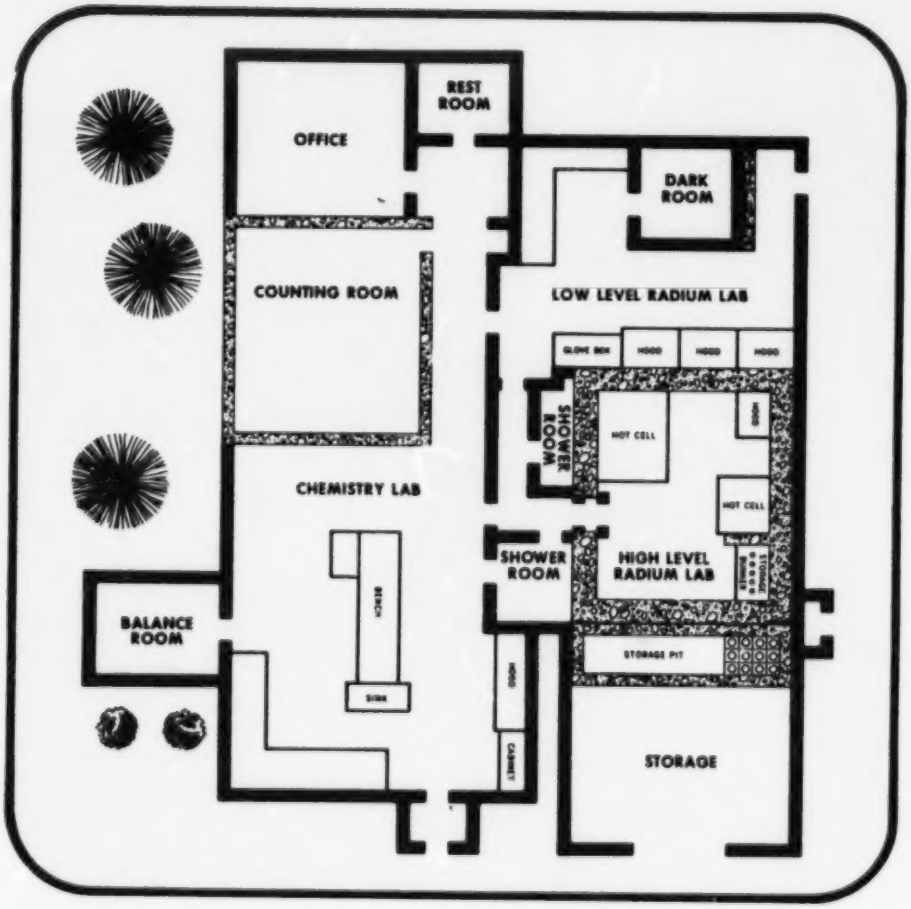

LIGHT-TIGHT ENCLOSURE
A
SOURCE
PHOSPHOR
LENS
SUPPORT
FILM
B
SOURCE
SHIELD
CONTAINER
PHOSPHOR
FILM

Examples of typical results generally produced from photographic leak tests are shown at the right. The smaller image resulting from method (a) indicates the leaking or contaminated nature of a circular plaque. The larger image represents results of applying method (b) to the same plaque and suggests the presence of unsealed radium.

Early discovery of faulty sources by regular and frequent testing, which is possible with the photographic technique, reduces the chances of uncontrolled radiation exposure or widespread contamination. The photographic technique is a safe, effective system which can be used by medical and radiation control personnel as part of their procedure for protecting physicians, patients, and others against unnecessary radiation exposure.

In addition to continuously investigating better and more rapid means of leak testing sealed radium sources, the Radioactive Materials Investigation Section compares commonly used leak test procedures to establish uniformity in interpretation of data resulting from these tests.




REST ROOM
OFFICE
DARK ROOM
COUNTING ROOM
LOW LEVEL RADIUM LAB
GLOVE BOX
HOOD
HOOD
HOOD
SHOWER ROOM
HOT CELL
HOOD
HOT CELL
CHEMISTRY LAB
SHOWER ROOM
HIGH LEVEL RADIUM LAB
BENCH
BALANCE ROOM
BENCH
SINK
HOOD
CABINET
STORAGE PIT
STORAGE

RECEIVED
NATIONAL TECHNICAL
JAN 04 1973
INFORMATION SERVICE

29

Other areas of investigation which are under observation include structural testing and physical assessment of sealed sources, evaluation of radiation received by radium users and development of improved techniques for radium decontamination. Problems connected with decontamination center primarily on creating rapid, economic, and efficient techniques for removing radium and its daughter products from the surface of various materials. Current methods are generally time consuming, costly, and produce large volumes of waste cleaning material.

The SERHL research program in radium technology is conducted in a laboratory shown at the left which was designed to provide safe working areas for personnel involved in these activities. To insure that the building is free of dangerous radiation levels, the radioisotope research laboratory and the main entrance are constantly monitored by automatic audible and visual radiation alarm systems in addition to the use of portable survey meters in the laboratory.

Through the radioisotope storage capability at the Southeastern Radiological Health Laboratory, dangerously leaking or damaged radium sources may be safely isolated from the population. Studies to establish standards and guidelines for the safe handling of radium and techniques for efficient storage, handling, and examination of radium sources will help contribute measurably to the overall radiological health program.

THE SOUTHEASTERN RADIOLOGICAL HEALTH LABORATORY
P.O. BOX 61
MONTGOMERY, ALABAMA 36101

GPO 979-918

SPAVIN/70